BOTANY.

Some Elementary Botanies.—That there is a dissatisfaction with the commoner methods of teaching botany as set forth in the text books, is indicated by the numerous attempts of various teachers to give us better books. In no other science is there to-day such diversity of opinion as to the best method of introducing the pupil to the subject to be studied. As a result we have a multiplication of elementary books, each designed to lead the pupil into his work by a different route. For twenty years the little books by Miss Youmans have stood as a sort of protest against mere "book botany." Though faulty in many particulars, they were valuable in showing that there are other ways of teaching botany than the stereotyped ones. A recent book, "Descriptive Botany," by the same author, has much in it to commend. At the very beginning the pupil is told to supply himself with his own material for examination. He is told to "gather a variety of leaves; and to begin their study by comparing them," etc., etc. Further on we find this: "Pull up any herb which has a distinct stem, and compare the stem with the root," and so on repeatedly. This is excellent, and the pupil cannot fail to be greatly benefited by such a course. There is too marked an emphasis given to technical terms, which are needlessly printed in italics, and too frequently there is a dictionary-like brevity, as when we read that "The leaf of a fern is called a *frond*," and "The stalk or petiole of a frond is called a *stipe*." Why this is so is not hinted. The "Popular Flora" is just what it pretends to be—popular—and will be useful to the beginner who has prepared himself aright to take it up. It contains brief but plain descriptions of the more common flowering plants including cultivated as well as wild species. It is pleasant to note that the Gymnosperms are assigned to their proper place between Angiosperms and the Pteridophytes. It is not so pleasant, however, to note that the explanation of the structure of the flowers of the Conifers (the sole representatives of the Gymnosperms) is wholly erroneous. There has been an attempt to carry the old and discarded ideas as to floral structure over into the new classification. The Conifers as described in this book should go back into their old position, sandwiched between the Monocotyledons and Dicotyledons!

In many points the "High School Botany," prepared by H. B. Spotton for the use of Canadian students, has a considerable resem-

blance to Miss Youmans's work noticed above. There is the same admiration and following of Henslow's "schedules" for analysis, the same examination of representative plants, while in each there are several chapters given to generalizations. Most of the work of preparing this volume appears to be well done, but there are evidences here and there of haste. Thus while the true nature of the lichens is recognized on page 202, a little further on (p. 206) we have the old statement that "the lichens, from their peculiar constitution, may be regarded as transitional between the Algæ and the Fungi." Here we have a little new wine (p. 202) in a very old bottle (p. 206). The "Flora for the Use of Beginners" in this book is much like Miss Youmans's "Popular Flora." It is really a very useful little manual.

A recent English book, Edmonds's "Elementary Botany," has been placed before the American public by Longmans of New York. It is a much more scientific book than either of the preceding, although like them it teaches botany by observation. The principal difference is that the observation in this book is more profound, and is directed to essential rather than to superficial characters. The student is brought to study the plant as a living thing, rather than an object to be classified and labeled. We find that while 153 pages are given to structure and physiology, but 35 are devoted to classification. A few orders are selected, and in each a typical plant is suggested for study, while a few others are cited as common examples. The book is a very good one.

Dr. Campbell's "Structural and Systematic Botany," which has recently been brought out by Ginn & Co., is an attempt to supply a small and handy introduction to all parts of the vegetable kingdom. It is based upon, and to a certain extent is an abridgement of, Goebel's "Outlines of Classification and Special Morphology of Plants," a work of great usefulness to the student in spite of its considerable cost. This introduction will be welcome to many a teacher and student who cannot afford the larger work.

After a few introductory pages devoted to methods of work, and a brief examination of the cell, the Protophytes are taken up, nine pages being devoted to them. Then follow in order the Algæ, Fungi, Bryophytes, Pteridophytes, and Spermaphytes. Very good outline drawings, largely original, accompany the text. A commendable feature of the work is the adoption of Eichler's arrangement of the flowering plants.

Here and there slips, due doubtless to haste, are noticed. Thus the figures B, C, and D, on page 132, are certainly not of "year-old cones of Scotch Pine," and on page 131 the relation of scale and "ovule-bearing leaf" are badly confused. There is also a looseness in

the quotation of the titles of works of reference and the names of authors and publishers on pp. 235-6. We note further that Ustilago is persistently spelled Ustillago.—CHARLES E. BESSEY.

The Completion of Saccardo's Sylloge Fungorum.—Eight years ago the first volume of this great work appeared, and this has been followed by others in rapid succession until now we have the eighth and final volume of the series. In these thick volumes, which aggregate more than eight thousand pages, nearly thirty-two thousand species have been described (exactly, 31,927). The completion of so great a labor in so brief a space of time must excite at once our wonder and admiration. We have here a work of vast extent, whose first and last volumes are near enough together in time, so that they are not appreciably separated by any change in plan, due to a change of view on the part of the authors. Whatever we may say of the plan of the work, and however much we may wish that a different one had been adopted, it is comfortable to know that here at least is a book completed upon the lines laid down by its author less than a decade ago. It is cheerful, also, to think that a generation has not died during the publication of the work, but that nearly all who saw its beginning have seen its completion. Thus the depressing influence of De Candolle's "Prodromus," dragging its way through fifty years to incompletion, is counteracted, and we may again hope to see great undertakings inaugurated.

If we take the great masses of families as worked in this book, and make a distribution in an approximately natural system, we get a better idea of the numbers and extent of the fungi. For convenience of reference the number of species in each family is given, and the total number in each order or class.

PROTOPHYTA.

MYXOMYCETEÆ.—(Vol. VII.)—Monadinaceæ, 49 species; Sorophoraceæ, 9; Myxomycetaceæ, 383. Total, 441 species.

SCHIZOPHYTA.—Schizomycetaceæ, 659 species. (Vol. VIII.)

ZYGOPHYTA.

CONJUGATÆ.—Protomycetaceæ, 19; Chytridiaceæ, 132. (Vol. VIII.); Entomophthoraceæ, 20; Mucoraceæ, 200. (Vol. VII.); Total, 371 species. (Vol. VII.)

OÖPHYTA.

CŒOELOBLASTEÆ.—Saprolegniaceæ, 80; Peronosporaceæ, 96. Total, 176 species. (Vol. VII.)

CARPOPHYTA.

ASCOMYCETEÆ.

PYRENOMYCETEÆ.—(Vols. I., II., and Add.)—Perisporiaceæ, 481; Sphæriaceæ, 5448; Coryneliaceæ, 2; Hypocreaceæ, 640; Dothidiaceæ, 351; Microthyriaceæ, 65; Lophiostomaceæ, 213; Hysteriaceæ, 372; Hermihysteriaceæ, 3. Total, 7575 species.

HYPODERMEÆ.—(Vol. VII.)—Uredineæ, 1224; Ustilagineæ, 284. Total, 1508 species.

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Phymetosphæriaceæ, 16; Onygenaceæ, 6; Laboulbeniaceæ, 15. Total, 37 species. (Vol. VIII.)

SPHÆROPSIDEÆ.—(Vol. III.)—Sphærioidaceæ, 3690; Nectrioidaceæ, 44; Leptostromaceæ, 203; Excipulaceæ, 143. Total, 4080 species.

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Melanconiaceæ, 606 species. (Vol. III.)

HYPHOMYCETEÆ.—(Vol. IV.)—Mucedinaceæ, 1147; Dematiaceæ, 1579; Stilbaceæ, 344; Tuberculariaceæ, 594. Total, 3664 species.

SACCHAROMYCETEÆ.—Saccharomycetaceæ, 30 species. (Vol. VIII.)

DISCOMYCETEÆ.—(Vol. VIII.)—Caliciaceæ, 78; Gymnoascaceæ, 51; Cordieritaceæ, 5; Patellariaceæ, 161; Phacidiaceæ, 268; Stictaceæ, 229; Bulgariaceæ, 152; Dermateaceæ, 255; Ascobolaceæ, 130; Pezizaceæ, 1948; Heloellaceæ, 169; Cyttariaceæ, 7. Total, 3453 species.

TUBEROIDEÆ.—(Vol. VIII.)—Elaphomycetaceæ, 21; Cenoccocaceæ, 1; Tuberaceæ, 102; Endogonaceæ, 6. Total, 130 species.

BASIDIMYCETEÆ.

GASTEROMYCETEÆ.—(Vol. VII.)—Hymenogastraceæ, 78; Lycoperdaceæ, 426; Nidulariaceæ, 61; Phallaceæ, 81. Total, 646 species.

HYMENOMYCETEÆ.—(Vols. V. and VI.)—Tremellaceæ, 258; Clavariaceæ, 371; Thelephoraceæ, 884; Hydnaceæ, 427; Polyporaceæ, 1972; Agaricaceæ, 4639. Total, 8551 species.

There are thus 1100 species of Protophytes; 371 of Zygophytes; 176 of Oöphytes, and 30,280 of Carpophytes. Of the latter again there are 12,703 Ascomyceteæ; 9,197 Basidiomyceteæ, with 8,380 probably, but not certainly, imperfect stages of the former.

CHARLES E. BESSEY.

The Preparation of Vegetable Tissues for Sectioning on the Microtome.—Vegetable tissues vary so much as to the amount of protoplasm, cellulose, and other substances contained, that the

methods used for obtaining good sections from them must vary greatly. I have prepared and sectioned fungi, lichens, the cotyledons, plumules, hypocotyledonary stems, roots, and root-tips of the cucumber, young pine cones, young wheat blades, lilac buds, and bean stems, with varying degrees of success.

Lichens, and the young firm cotyledons of the cucumber could be dehydrated, and permeated with paraffine much more rapidly than young meristemic tissue, or tissue composed largely of cellulose and water. The former may be placed in 50 per cent., 75 per cent., 90 per cent., and 100 per cent. alcohol, chloroform, chloroform and paraffine, and finally in paraffine, at a temperature of 55° C., remaining in each from two to twelve hours, and good results may be obtained.

But the meristemic and the thin-walled watery tissue must be treated differently, or the tissue will come through very much shrunken and distorted—worthless biologically.

I have had the most success following the method described by Dr. J. W. Moll, in the *Botanical Gazette* for January, 1888. I have obtained good sections from all the material that I have treated in this way. I used a 1 per cent. solution of chromic acid and 20 per cent., 35 per cent., 50 per cent., 75 per cent., and 90 per cent. alcohols for dehydrating. The chromic acid seems to fix the protoplasm, and macerate the cellulose, allowing the alcohols to pass more freely. I allowed the specimens to remain in the several per cents. of alcohol from two to twenty-four hours, according to their size and texture. As as rule, I found that the more gradually the specimens were dehydrated the better. From absolute alcohol, the specimens were placed in a solution of equal parts of turpentine and paraffine. The solution containing the specimens was then raised gradually from a temperature of 20°+ C. to about 45° C. They were then placed in melted paraffine, kept as nearly at 50° C. as possible. Small specimens will be permeated in one or two hours, but large specimens require from four to six hours.

From the 75 per cent. alcohol I placed the specimens in a stain. The stains I tried were alum cochineal, hæmatoxylin, fuchsin, methyl green, methyl blue, methyl violet, and ammonia carmine. I found alum cochineal a good stain for fungi, plumules, stems, roots, and root-tips, but it would not penetrate the cucumber cotyledons, Fuchsin would penetrate anything I tried; but as it is soluble in alcohol it is necessary to over-stain the specimens, and then allow the coloring to come out until it is about right. Hæmatoxylin stained all the tissue that I tried except the young cucumber cotyledons. This stain gives

large specimens a dark blue color on the outside, and a purplish pink color on the interior. The nuclei and the cell walls are brought out clearly. I did not have good success with the methyl colors, as they were easily dissolved out by the alcohol.

If specimens have not taken sufficient color, or if the alcohol has removed too much of the color, sections can be stained upon the slide, after they are cut. Any stain can be used, but none that I tried differentiated the parts sufficiently. Fuchsin will give enough color in a few seconds. The sections must stand in hæmatoxylin from two to ten minutes, and in alum cochineal from ten to twenty minutes. If it is intended to stain upon the slide, an alum fixative will be found better than collodion.

I heated the slides in the gas flame to melt the paraffine, and poured on turpentine to wash it out. The specimens were then mounted in balsam dissolved in chloroform. Air bubbles that appear when sections are first mounted, will disappear after the slides stand a few hours. If the razor or knife used for cutting is very sharp, small specimens may be cut 1-2500, or even 1-5000 of an inch in thickness. But larger specimens cannot be cut more than 1-600 to 1-1500 of an inch thick without crowding the tissues together, and giving them the appearance of being shrunken.—A. J. McClatchie, *Lincoln, Neb.*

ZOOLOGY.

The Ontogeny of Limulus.—The following is preliminary to a more detailed account, with ample illustrations, which will be published soon. The work was done in the Marine Biological Laboratory at Woods Holl, Mass., during the summers of 1889 and 1890. In my views of the earlier stages, as seen from the surface, I fail to corroborate Osborn's account[1] in many particulars. The eggs were artificially fertilized, and were carried through until hatching.

(1) The segmentation nucleus is subcentral, and is surrounded by a thin pellicle of protoplasm. It undergoes several divisions before any signs of segmentation are visible from the surface. The products of this division migrate more rapidly toward that pole of the egg where the germ is subsequently to appear than to any other portion of the surface. Forty hours after impregnation the egg itself begins to segment, and this segmentation has in its general appearance a meroblastic character,

[1] Johns Hopkins University Circular, No. 43, 1885.